e^+e^- in the VLHC Tunnels

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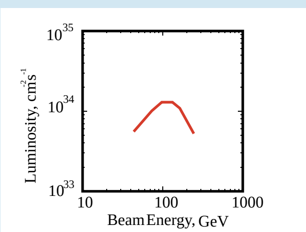
Purpose

- Proven LEP technology
- Complementary to LHC physics
- Studies of
  - EW physics of W and Z
  - Light higgs
  - Heavy lepton pairs
  - Light SUSY states
  - $t\bar{t}$ with high resolution
- Upgrade to pp collider
- 100 years at the energy frontier . .

Parameters

Circumference, km	233
Max. beam energy, GeV	200
Bunch intensity,	4.85×10^{11}
Arc Tune	215
Cell Length, m	189
Energy loss/turn, GeV	4
Energy spread, E_{cm}, GeV	0.25
RF Voltage, GV	4.6
Bunch Length, mm	7
Max. dipole field, T	0.0238

Luminosity is a function of energy.



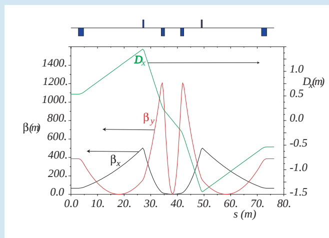
Physics

The luminosity is $L \propto \xi_y P_T \rho / \beta_y^* \gamma_y^3$ so collider performance is determined by a few parameters.

ξ_y, the beam beam tune shift, may have been stable up to 0.14 at LEP, and 0.17 used here.

P_T, the total power in two beams is 100 MW.

β_y^*, the IP beta function be could be 0.01 m.



Transverse mode coupling instability (TMCI) may not be a significant limit if the vacuum chamber is large, the use of bellows is minimized and the injection energy is comparatively high.

Polarization is not completly understood. The Sokolov Ternov time is $\tau \sim 6$ hr (200 GeV / E), and the maximum polarization is given a function of the resonance strengths.

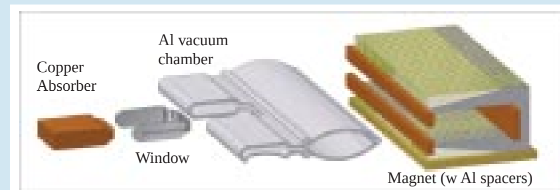
Parasitic collisions are totally avoided with two rings, and the bunch separation is greater than twice the straight section length.

The optimum injector energy may be 45 GeV, which would minimize TMCI limitations at injection, and would also operate as a dedicated, optimized *W* and *Z* factory.

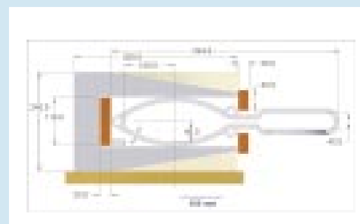
Problems

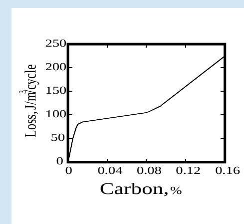
The IP optics and rf systems are somewhat similar to the LEP design.

The vacuum system assumes a "no bake, no bellows" design that uses prebaked chamber sections welded in-situ. The chamber itself is an aluminum extrusion with sections for the beam and synchrotron fan. The synchrotron power is mostly absorbed by lumped absorbers outside the vacuum chamber at intervals of ~ 50 m. At high energies much of the x-ray power exits the vacuum chamber to a copper absorber in air.



The low field magnet consists of 1 mm laminations separated by 1 cm Al spacers. The conductors are aluminum, close to the median plane to improve error fields. External fields are attenuated by 1) a magnetic shield around the machine, and 2) by the magnet yokes themselves. Remanent fields are minimized by the use of very low carbon steel obtained by vacuum annealing.





The rf system will use niobium sputtered on Cu technology with a total voltage of 4.66 GV of 352 MHz cavities operating at an accelerating field of 8 MV/m, with a total active length of 585 m.

R&D Issues:

- What are the limits on β_y^*, ξ_y, and bunch spacing?
- How can one combat TMCI, (feedback, bunch coalescence etc.)?
- What is the minimum bunch spacing?
- What is the optimum magnet / vacuum chamber design?